In-Well Monitoring System for Vertical Profiling of DNAPL Contaminants

Technology Need:

Numerous DOE and industrial sites have soil and groundwater contaminated with volatile organic contaminants (VOCs) including Dense Non-Aqueous Phase Liquids (DNAPLs). At many DOE sites, long-term monitoring of these contaminants is anticipated as part of the long-term stewardship activities. The DOE needs monitoring systems that have remote, automated and *in situ* capabilities in order to reduce the high cost of manual sampling and laboratory analysis. "Monitored Natural Attenuation" has recently gained acceptance as a long-term approach to subsurface contamination and will require technological advancements to support the emphasis on monitoring. General Electric (GE), a partner in this project, is responsible for over 87 superfund sites and has recognized the need for improved long-term monitoring technology at its own sites.

Technology Description:

GE and Nomadics, Inc. have teamed to develop and validate an automated inwell monitoring system (AIMS) to characterize vapor- and dissolved-phase dense DNAPL, such as carbon tetrachloride and trichloroethylene, in the groundwater and vadose zones. The monitoring system takes advantage of low-cost, chemical sensor array technology developed by GE for long-term monitoring of environmental contaminants in groundwater wells. The goal of the project is to produce an automated monitoring system that meets the needs of the DOE and commercial users. GE has partnered with Nomadics to provide design support, prototyping, and commercialization of the technology.

The heart of the AIMS system is the sensor probe, which contains an array of thickness shear mode (TSM) sensor crystals. A schematic of the sensor probe is shown in Figure 1. Each transducer in the array is coated with a different polymer coating. At each sampling location, organic vapors permeate the membrane into the headspace surrounding the sensor array. For aqueous samples, the membrane serves to separate and concentrate the chlorinated hydrocarbons in the headspace according to Henry's Law. Key to the high sensitivity of the AIMS system is the sensor array. GE has developed a family of polymeric materials with high sensitivity toward chlorinated solvents and their daughter products.

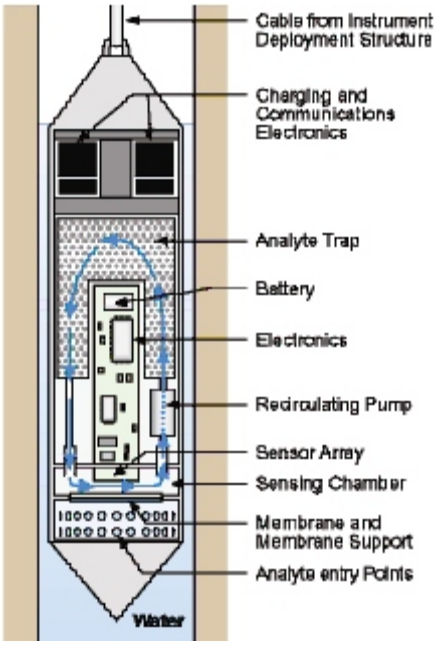

Figure 1. AIMS Sensor Probe

The AIMS Probe is part of an in-well monitoring system capable of chemical detection, vertical profiling, and long-term monitoring of dissolved organic compounds. The system is capable of sampling both the vadose and groundwater zones and can be used in monitoring wells 2 inches in diameter or greater. For *in situ* quantification, the expected calibration range of the system will extend from 5-10,000 mg/L in groundwater and 1-1,000 mg/L in the vadose zone for trichloroethylene (or carbon tetrachloride (CTC) and other co-contaminants.

The system has several unique features and operating modes (see Figure 2). The probe is capable of traveling up and down the well via a programmable controller and precision winch located at the well head. The AIMS probe has a self-cleaning or scrubbing cycle to remove organic vapors from the probe between samples. The probe is automatically brought to the surface for wireless data debriefing and battery regeneration via magnetic induction. Future development of the system will likely incorporate solar power and wireless communication for remote operation.

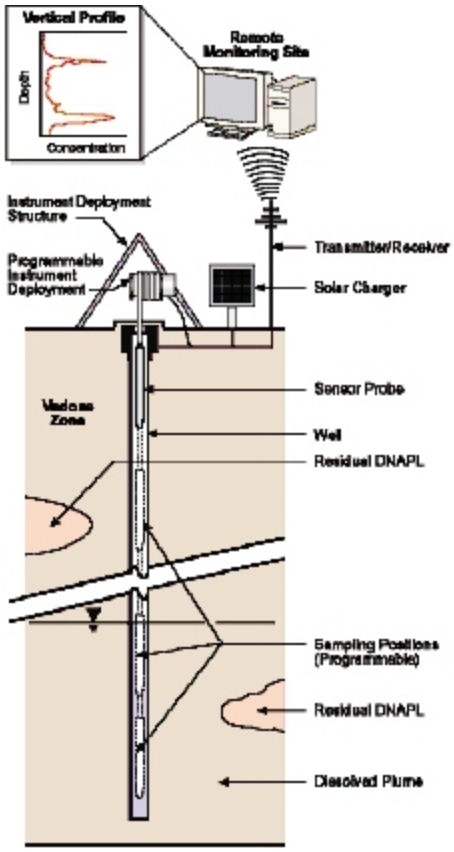

Figure 2. Aims Concept for Vertical Profiling

Benefits:

- In-situ, automated sampling and analysis
- Lower cost compared to manual sampling and laboratory analysis
- Discrete sampling capability for groundwater and soil gas
- Applicable to a wide range or organic contaminants
- Fast turnaround time
- Low detection limits

Status and Accomplishments:

This project was started in September of 2001 and will be executed in two phases, with the second phase being optional. Phase I consists of advanced engineering design work, construction of prototype units, prototype control testing, pilot field tests at a DOE site, and supporting activities. The Savannah Rivers Site (SRS) has been identified as a potential location for field testing and GE and SRS representative have initiated planning activities. If the Phase II option is exercised, the second phase will include modification of the design as indicated by Phase I test results and customer feedback and a full-scale demonstration of the technology system with supporting activities.

Contacts:

Ron Shaffer
General Electric Corporate R&D
Phone: (518) 387-4344
E-mail: shaffer@crd.ge/.com

Karen L. Cohen
National Energy Technology Laboratory
Phone: (412) 386-6667
E-mail: karen.cohen@netl.doe.gov

Online Resources:

Office of Science and Technology, Technology Management System (TMS), Tech ID # 3157
http://ost.em.doe.gov/tms

The National Energy Technology Laboratory Internet address is http://www.netl.doe.gov